UNITED STATES PATENT AND TRADEMARK OFFICE

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10/580,774	05/07/2007	Wenli Cai	8095-12 US	7251

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EXAMINER
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ART UNIT	PAPER NUMBER
2624	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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	Application No.	Applicant(s)
Office Action Summary	10/580,774	CAI, WENLI
	Examiner	Art Unit	
	TAHMINA ANSARI	2624	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>07 May 2007</u>.
2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1-29</u> is/are pending in the application.
    4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☒ Claim(s) <u>14-16</u> is/are allowed.
6)☒ Claim(s) <u>1,11-13 and 17-29</u> is/are rejected.
7)☒ Claim(s) <u>2-10</u> is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☒ The drawing(s) filed on <u>26 May 2006</u> is/are: a)☐ accepted or b)☒ objected to by the Examiner.
    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
    a)☐ All   b)☐ Some * c)☐ None of:
      1.☐ Certified copies of the priority documents have been received.
      2.☐ Certified copies of the priority documents have been received in Application No. _____.
      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO/SB/08)
    Paper No(s)/Mail Date _____.
4)☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date. _____.
5)☐ Notice of Informal Patent Application
6)☐ Other: _____.

DETAILED ACTION

1.   Claims 1-29 are pending in this application.

Drawings

2.   The drawings are objected to because Figure 1A appears to be prior art in

accordance with the description and the specification and is not labeled as such. Figure

1A should be designated by a legend such as --Prior Art-- because only that which is

old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37

CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the

application. The replacement sheet(s) should be labeled "Replacement Sheet" in the

page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing

figures. If the changes are not accepted by the examiner, the applicant will be notified

and informed of any required corrective action in the next Office action. The objection to

the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 101

3.   35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of
> matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the
> conditions and requirements of this title.

4.   Claims 17-29 are rejected under 35 U.S.C. 101 because the claimed invention is

directed to non-statutory subject matter.

Claim 17 is drawn to functional descriptive material recorded on "a program storage

device readable by a computer". Normally, the claim would be statutory. However, the

broadest reasonable interpretation of a claim drawn to "a program storage device

readable by a computer" typically covers forms of non-transitory tangible media as well

as transitory propagating signals per se, making the recited claim language directed

towards non-statutory subject matter such as a "signal".

> *"A transitory, propagating signal ... is not a "process, machine, manufacture, or*
>
> *composition of matter." Those four categories define the explicit scope and*
>
> *reach of subject matter patentable under 35 U.S.C. § 101; thus, such a signal*
>
> *cannot be patentable subject matter." (In re Nuijten, 84 USPQ2d 1495 (Fed. Cir.*
>
> *2007)).*

Likewise, claims 18-29 are dependent upon Claim 17 and fail to overcome the problem

recited for claim 17. Because the full scope of the claim as properly read in light of the

disclosure appears to encompass non-statutory subject matter (i.e., because the

specification is silent to the exact embodiment of a computer readable medium, it is

interpreted as including the ordinary and customary meaning of computer readable

medium covering both non-transitory media and transitory propagating signals, etc.) the

claim as a whole is non-statutory. In view of the USPTO's Interim Examination

Instructions for Evaluating Subject Matter Eligibility under 35 U.S.C. 101 (the

"Guidelines"), and the Official Gazette Notice (1351 OG 212, made available February

23, 2010), the examiner suggests amending the claim to include the limitation "non-

transitory" in order to exclude any non-statutory subject matter. Any amendment to the

claim should be commensurate with its corresponding disclosure.

Claim Rejections - 35 USC § 103

5.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

6.   Claims 1, 11-13, 17, and 27-29 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Carroll et al. (US Patent 6,501,848 B1, hereby referred to as

"Carroll"), in view of Yanof et al. (US Patent 5,734,384, hereby referred to as "Yanof"),

further in view of Kanitsar et al. ("Advanced Curve Planar Reformation: Flattening of

Vascular Structures", IEEE Visualization 2003, October 2003, hereby referred to as

"Kanitsar").

          Consider Claim 1:

          Carroll teaches:

                    -a; "A method of visualizing a vascular structure, said method comprising

                    the steps of" **(Carroll: abstract, column 3 lines 12-68, column 4 lines 1-**

47, column 7 lines 1-62, Figure 1; methods and systems to view 3D

reconstruction of vascular structures):

-b; "providing a digital image of a vascular structure wherein said image

comprises a plurality of intensities corresponding to a domain of points in

a D-dimensional space" **(Carroll: column 7 lines 1-67, column 8 lines 1-**

42, Figure 1, 9-13; Figure 9 details the methods for defining

segments and extracting features from the arterial tree based on

intensities);

-c; "selecting a vascular central axis and a vector of interest in the image

of the vascular structure, and forming a plurality of cross sections

perpendicular to said vascular central axis" **(Carroll: column 8 lines 19-**

67, columns 9 lines 1-46, column 15 lines 19-67, column 16, column

17 lines 1-35, Figures 19, 20, and 27; a vascular central axis

represented by the centerline points in the arterial tree are selected,

and cross sectional planes tangential to the vessel centerline are

selected);

-f; "and rendering an image of said vascular structure" **(Carroll: column**

26 lines 65-68, column 27 lines 1-38, Figure 52; a display of the color

coded arterial tree is rendered)

Bailey does not teach:

-d; "forming a convex hull to enclose each cross section, wherein said

convex hull is oriented by said vector of interest and determined by the

shape of the cross section";

-e; "connecting each convex hull to form a biconvex slab";

-f; "and rendering said biconvex slab to form an image of said vascular

structure".

Yanof teaches:

-a; "A method of visualizing a vascular structure, said method comprising

the steps of" **(Yanof: abstract, column 2 lines 49-68, column 3 lines 1-

15, column 4 lines 48-62, column 5 lines 54-68, column 6 lines 1-31,

Figures 1-2; a vascular structure can be visualized)**:

-b; "providing a digital image of a vascular structure wherein said image

comprises a plurality of intensities corresponding to a domain of points in

a D-dimensional space" **(Yanof: column 5 lines 54-68, column 6 lines 1-

53, Figures 1-2)**;

-c; "selecting a vascular central axis and a vector of interest in the image

of the vascular structure, and forming a plurality of cross sections

perpendicular to said vascular central axis" **(Yanof: column 6 lines 48-

68, column 7 lines 1-30, Figures 2, 3A-3, 4A-C; a vascular central axis

is defined (38), and a plurality of cross sections perpendicular or

orthogonal to the axis are formed)**;

-d; "forming a convex hull to enclose each cross section, wherein said

convex hull is oriented by said vector of interest and determined by the

shape of the cross section" **(Yanof: column 4 lines 48-62, column 9**

lines 25-55, column 10 lines 57-68, column 11 lines 1-25, column 12

lines 17-30, lines 65-68, column 13 lines 1-5, column 14 lines 17-68,

column 15 lines 1-17, Figures 6A-6F; convex polygon edges

representing convex hulls are connected together to form a convex

face polyhedron representing a biconvex slab based on the shape of

the cross section);

-e; "connecting each convex hull to form a biconvex slab" **Yanof: column**

4 lines 48-62, column 9 lines 25-55, column 10 lines 57-68, column 11

lines 1-25, column 12 lines 17-30, lines 65-68, column 13 lines 1-5,

column 14 lines 17-68, column 15 lines 1-17, Figures 6A-6F; convex

polygon edges representing convex hulls are connected together to

form a convex face polyhedron representing a biconvex slab based

on the shape of the cross section);

-f; "and rendering said biconvex slab to form an image of said vascular

structure" **(Yanof: column 15 lines 54-68, column 16 lines 1-32,**

Figures 7A-7D; the curved surfaces in the planar polyhedral volume

can be displayed for the user as curved sections through the

volumetric region).

It would have been obvious to one of ordinary skill in the art at the time of the

invention to combine the teachings of Carroll with the teachings of Yanof

because they are both directed towards methods and systems for three-

dimensional vascular image data reconstruction. Carroll teaches a "base" method

and system for three-dimensional coronary vascular tree reconstruction from

multiple image datasets through the establishment of a vessel centerline and

image transformation **(Carroll: abstract)**. Yanof teaches a "comparable" method

and system for three-dimensional volumetric data reconstruction using a convex

polyhedron polygon in the transformation and plane section defining means for

determining the appropriate three-dimensional structure **(Yanof: abstract,**

column 2 lines 49-67, column 3 lines 1-15, column 14 lines 29-53). Yanof's

known teachings could have been applied in the same way to the "base"

teachings of Carroll, yielding predictable results. One of ordinary skill in the art, at

the time of the invention, would have been motivated to combine the teachings of

Carroll with the teachings of Yanof in order to take advantage of an interactive

three-dimensional reconstruction system that optimally "establishes the medial

axis within a hierarch of branching straight or curve tube-shaped objects such as

the vessels of a vascular tree", and "establishes a volume of interest which

contains a three-dimensionally convex item or sub region of interest such as a

vessel with multiple branches" and automates the determination of cross-

sectional areas within the vascular structure **(Yanof: column 4 lines 48-62)**.

Kanitsar further teaches:

-a; "A method of visualizing a vascular structure, said method comprising the steps of" **(Kanitsar: page 43-44 "Abstract" and section 1 "Introduction"; method proposed for vascular visualization by improving CPR methods using spiral/helical re-sampling around a central axis)**:

-b; "providing a digital image of a vascular structure wherein said image comprises a plurality of intensities corresponding to a domain of points in a D-dimensional space" **(Kanitsar: page 43-45 section 1 "Introduction", section 3 "Helical CPR"; non-invasive imaging data through CT/CTA or MR imaging data is gathered, wherein these datasets represent a plurality of intensities in a 2D or 3D space)**;

-c; "selecting a vascular central axis and a vector of interest in the image of the vascular structure, and forming a plurality of cross sections perpendicular to said vascular central axis" **(Kanitsar: page 43-45 section 3 "Helical CPR", Figures 2-3; a vessel central axis is defined, along with a spiral of interest and a plurality of cross sections perpendicular to the vascular central axis are determined as exemplified in Figure 3)**;

-d; "forming a convex hull to enclose each cross section, wherein said convex hull is oriented by said vector of interest and determined by the shape of the cross section" **(Kanitsar: pages 45-47 section 4 "Untangled CPR", Figures 6-7; a vascular tree is generated using**

vessel hulls to enclose each cross section, which are then combined

to form various parts of the vascular tree);

-e; "connecting each convex hull to form a biconvex slab" **(Kanitsar:**

pages 45-47 section 4 "Untangled CPR", Figures 6-7; a vascular tree

is generated using vessel hulls to enclose each cross section, which

are then combined to form various parts of the vascular tree);

-f; "and rendering said biconvex slab to form an image of said vascular

structure" **(Kanitsar: pages 47-48 section 4 "Untangled CPR", Figures**

6-7).

It would have been obvious to one of ordinary skill in the art at the time of the

invention to modify the combination of Carroll and Yanof with the teachings of

Kanitsar because they are all directed towards methods and systems for three-

dimensional vascular image data reconstruction. The combination of Carroll and

Yanof teaches a "base" method and system for three-dimensional coronary

vascular tree reconstruction from multiple image datasets through the

establishment of a vessel centerline and image transformation **(Carroll:**

abstract), that uses a convex polyhedron polygon in the transformation and

plane section defining means for determining the appropriate three-dimensional

structure **(Yanof: abstract, column 2 lines 49-67, column 3 lines 1-15,**

column 14 lines 29-53). Kanitsar teaches a "comparable" method for vascular

visualization using advanced curved planar reformation that improves upon

existing methods through the "relaxation of spatial coherence in favor of

improved feature perception" **(Kanitsar: abstract)**. Kanitsar's known teachings

could have been applied in the same way to the "base" combination of Carroll

and Yanof, yielding predictable results. One of ordinary skill in the art, at the time

of the invention, would have been motivated to modify the combination of Carroll

and Yanof with the teachings of Kanitsar in order to reduce the amount of

distortion, efficiently utilize the image space to provide an unobscured display of

the vascular tree, preserve isometry through the use of untangled CPR, and to

ensure the visualization of important clinical features for diagnosis **(Kanitsar:**

page 44 abstract, page 48 section 4.4 "Layout definition", page 49 section 4

"Conclusion and discussion") .

Consider Claim 11: The combination of Carroll, Yanof, and Kanitsar teaches "the

method of claim 1, further comprising displaying in three-dimensional a double-

oblique cross-sectional slab location" **(Carroll: column 17 lines 57-67, column**

18 lines 1-55, Figure 30; Yanof: column 8 lines 26-68, Figures 1 and 5;

oblique cross-sectional planes are displayed in a 3D view).

Consider Claim 12: The combination of Carroll, Yanof, and Kanitsar teaches "the

method of claim 1, further comprising the step of interactively rotating said image

of said vascular structure in order to determine a viewing vector" **(Yanof: column**

6 lines 48-68, column 7 lines 1-55, Figure 2, 3A-3D, 4A-4C; user-interactive

rotation is enabled of vascular models).

Consider Claim 13: The combination of Carroll, Yanof, and Kanitsar teaches "the

method of claim 1, further comprising the step of interactively zooming-in or

zooming-out said image of said vascular structure" **(Yanof: column 6 lines 35-**

47, column 15 lines 39-48, Figure 2; magnified or zoomed in versions of the

image are displayed and are available for user to interact with).

Consider Claim 17:

Carroll teaches:

> -a; "A program storage device readable by a computer, tangibly
>
> embodying a program of instructions executable by the computer to
>
> perform the method steps for visualizing a vascular structure, said method
>
> comprising the steps of" **(Carroll: abstract, column 3 lines 12-68,**
>
> **column 4 lines 1-47, column 7 lines 1-62, Figure 1; methods and**
>
> **systems to view 3D reconstruction of vascular structures)**:
>
> -b; "providing a digital image of a vascular structure wherein said image
>
> comprises a plurality of intensities corresponding to a domain of points in
>
> a D-dimensional space" **(Carroll: column 7 lines 1-67, column 8 lines 1-**
>
> **42, Figure 1, 9-13; Figure 9 details the methods for defining**
>
> **segments and extracting features from the arterial tree based on**
>
> **intensities)**;

-c; "selecting a vascular central axis and a vector of interest in the image

of the vascular structure, and forming a plurality of cross sections

perpendicular to said vascular central axis" **(Carroll: column 8 lines 19-**

67, columns 9 lines 1-46, column 15 lines 19-67, column 16, column

17 lines 1-35, Figures 19, 20, and 27; a vascular central axis

represented by the centerline points in the arterial tree are selected,

and cross sectional planes tangential to the vessel centerline are

selected);

-f; "and rendering an image of said vascular structure" **(Carroll: column**

26 lines 65-68, column 27 lines 1-38, Figure 52; a display of the color

coded arterial tree is rendered)

Bailey does not teach:

-d; "forming a convex hull to enclose each cross section, wherein said

convex hull is oriented by said vector of interest and determined by the

shape of the cross section";

-e; "connecting each convex hull to form a biconvex slab";

-f; "and rendering said biconvex slab to form an image of said vascular

structure".

Yanof teaches:

-a; "A program storage device readable by a computer, tangibly

embodying a program of instructions executable by the computer to

perform the method steps for visualizing a vascular structure, said method

comprising the steps of" **(Yanof: abstract, column 2 lines 49-68, column 3 lines 1-15, column 4 lines 48-62, column 5 lines 54-68, column 6 lines 1-31, Figures 1-2; a vascular structure can be visualized)**:

-b; "providing a digital image of a vascular structure wherein said image comprises a plurality of intensities corresponding to a domain of points in a D-dimensional space" **(Yanof: column 5 lines 54-68, column 6 lines 1-53, Figures 1-2)**;

-c; "selecting a vascular central axis and a vector of interest in the image of the vascular structure, and forming a plurality of cross sections perpendicular to said vascular central axis" **(Yanof: column 6 lines 48-68, column 7 lines 1-30, Figures 2, 3A-3, 4A-C; a vascular central axis is defined (38), and a plurality of cross sections perpendicular or orthogonal to the axis are formed)**;

-d; "forming a convex hull to enclose each cross section, wherein said convex hull is oriented by said vector of interest and determined by the shape of the cross section" **(Yanof: column 4 lines 48-62, column 9 lines 25-55, column 10 lines 57-68, column 11 lines 1-25, column 12 lines 17-30, lines 65-68, column 13 lines 1-5, column 14 lines 17-68, column 15 lines 1-17, Figures 6A-6F; convex polygon edges representing convex hulls are connected together to form a convex face polyhedron representing a biconvex slab based on the shape of the cross section)**;

-e; "connecting each convex hull to form a biconvex slab" **Yanof: column**

4 lines 48-62, column 9 lines 25-55, column 10 lines 57-68, column 11

lines 1-25, column 12 lines 17-30, lines 65-68, column 13 lines 1-5,

column 14 lines 17-68, column 15 lines 1-17, Figures 6A-6F; convex

polygon edges representing convex hulls are connected together to

form a convex face polyhedron representing a biconvex slab based

on the shape of the cross section);

-f; "and rendering said biconvex slab to form an image of said vascular

structure" **(Yanof: column 15 lines 54-68, column 16 lines 1-32,**

Figures 7A-7D; the curved surfaces in the planar polyhedral volume

can be displayed for the user as curved sections through the

volumetric region).

It would have been obvious to one of ordinary skill in the art at the time of the

invention to combine the teachings of Carroll with the teachings of Yanof

because they are both directed towards methods and systems for three-

dimensional vascular image data reconstruction. Carroll teaches a "base" method

and system for three-dimensional coronary vascular tree reconstruction from

multiple image datasets through the establishment of a vessel centerline and

image transformation **(Carroll: abstract)**. Yanof teaches a "comparable" method

and system for three-dimensional volumetric data reconstruction using a convex

polyhedron polygon in the transformation and plane section defining means for

determining the appropriate three-dimensional structure **(Yanof: abstract,**

column 2 lines 49-67, column 3 lines 1-15, column 14 lines 29-53). Yanof's
known teachings could have been applied in the same way to the "base"
teachings of Carroll, yielding predictable results. One of ordinary skill in the art, at
the time of the invention, would have been motivated to combine the teachings of
Carroll with the teachings of Yanof in order to take advantage of an interactive
three-dimensional reconstruction system that optimally "establishes the medial
axis within a hierarch of branching straight or curve tube-shaped objects such as
the vessels of a vascular tree", and "establishes a volume of interest which
contains a three-dimensionally convex item or sub region of interest such as a
vessel with multiple branches" and automates the determination of cross-
sectional areas within the vascular structure **(Yanof: column 4 lines 48-62)**.
Kanitsar further teaches:

> -a; "A method of visualizing a vascular structure, said method comprising
> the steps of" **(Kanitsar: page 43-44 "Abstract" and section 1
> "Introduction"; method proposed for vascular visualization by
> improving CPR methods using spiral/helical re-sampling around a
> central axis)**:
> -b; "providing a digital image of a vascular structure wherein said image
> comprises a plurality of intensities corresponding to a domain of points in
> a D-dimensional space" **(Kanitsar: page 43-45 section 1 "Introduction",
> section 3 "Helical CPR"; non-invasive imaging data through CT/CTA**

or MR imaging data is gathered, wherein these datasets represent a

plurality of intensities in a 2D or 3D space);

-c; "selecting a vascular central axis and a vector of interest in the image

of the vascular structure, and forming a plurality of cross sections

perpendicular to said vascular central axis" **(Kanitsar: page 43-45**

section 3 "Helical CPR", Figures 2-3; a vessel central axis is defined,

along with a spiral of interest and a plurality of cross sections

perpendicular to the vascular central axis are determined as

exemplified in Figure 3);

-d; "forming a convex hull to enclose each cross section, wherein said

convex hull is oriented by said vector of interest and determined by the

shape of the cross section" **(Kanitsar: pages 45-47 section 4**

"Untangled CPR", Figures 6-7; a vascular tree is generated using

vessel hulls to enclose each cross section, which are then combined

to form various parts of the vascular tree);

-e; "connecting each convex hull to form a biconvex slab" **(Kanitsar:**

pages 45-47 section 4 "Untangled CPR", Figures 6-7; a vascular tree

is generated using vessel hulls to enclose each cross section, which

are then combined to form various parts of the vascular tree);

-f; "and rendering said biconvex slab to form an image of said vascular

structure" **(Kanitsar: pages 47-48 section 4 "Untangled CPR", Figures**

6-7).

It would have been obvious to one of ordinary skill in the art at the time of the

invention to modify the combination of Carroll and Yanof with the teachings of

Kanitsar because they are all directed towards methods and systems for three-

dimensional vascular image data reconstruction. The combination of Carroll and

Yanof teaches a "base" method and system for three-dimensional coronary

vascular tree reconstruction from multiple image datasets through the

establishment of a vessel centerline and image transformation **(Carroll:**

abstract), that uses a convex polyhedron polygon in the transformation and

plane section defining means for determining the appropriate three-dimensional

structure **(Yanof: abstract, column 2 lines 49-67, column 3 lines 1-15,**

column 14 lines 29-53). Kanitsar teaches a "comparable" method for vascular

visualization using advanced curved planar reformation that improves upon

existing methods through the "relaxation of spatial coherence in favor of

improved feature perception" **(Kanitsar: abstract)**. Kanitsar's known teachings

could have been applied in the same way to the "base" combination of Carroll

and Yanof, yielding predictable results. One of ordinary skill in the art, at the time

of the invention, would have been motivated to modify the combination of Carroll

and Yanof with the teachings of Kanitsar in order to reduce the amount of

distortion, efficiently utilize the image space to provide an unobscured display of

the vascular tree, preserve isometry through the use of untangled CPR, and to

ensure the visualization of important clinical features for diagnosis **(Kanitsar:**

page 44 abstract, page 48 section 4.4 "Layout definition", page 49 section 4

"Conclusion and discussion") .

Consider Claim 27: The combination of Carroll, Yanof, and Kanitsar teaches "the

computer readable program storage device of claim 17, the method further

comprising displaying in three-dimensional a double-oblique cross-sectional slab

location" **(Carroll: column 17 lines 57-67, column 18 lines 1-55, Figure 30;**

Yanof: column 8 lines 26-68, Figures 1 and 5; oblique cross-sectional

planes are displayed in a 3D view).

Consider Claim 28: The combination of Carroll, Yanof, and Kanitsar teaches "the

computer readable program storage device of claim 17, the method further

comprising the step of interactively rotating said image of said vascular structure

in order to determine a viewing vector" **(Yanof: column 6 lines 48-68, column 7**

lines 1-55, Figure 2, 3A-3D, 4A-4C; user-interactive rotation is enabled of

vascular models).

Consider Claim 29: The combination of Carroll, Yanof, and Kanitsar teaches "the

computer readable program storage device of claim 17, the method further

comprising the step of interactively zooming-in or zooming-out said image of said

vascular structure" **(Yanof: column 6 lines 35-47, column 15 lines 39-48,**

Figure 2; magnified or zoomed in versions of the image are displayed and are available for user to interact with).

Allowable Subject Matter

7.   Claims 2-10 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The following is a statement of reasons for the indication of allowable subject matter.

a.   Claim 2 is not rejected because the prior art fails to teach the method of Claim 1, which specifically comprises the following features in combination with other recited limitations:

-; The method of claim 1, wherein said rendering further comprises the steps of:

-; defining a viewing vector perpendicular to a plane containing the vector of interest and the vascular central axis forming a scan line through the vascular structure and along the vector of interest, wherein said scan line includes a left point, a center point, and a right point;

-; forming a square bounding box about the convex hull, wherein the intersection of each scan line with the bounding box defines a rendering range;

-; and emitting a ray through each pixel within the rendering range,

wherein the rendering depth of the ray is within the maximum radius of the

hull.

As claims 3-10 are dependent upon claim 2, they too carry forth the same

limitations, and are not taught by the prior art.

8.   Claims 18-26, likewise would be allowable if rewritten to overcome the

rejection(s) under 35 U.S.C. 101, set forth in this Office action and to include all of the

limitations of the base claim and any intervening claims.

b.   Claim 18 is objected to because the prior art fails to teach the method of

Claim 17, which specifically comprises the following features in combination with

other recited limitations:

-; The computer readable program storage device of claim 17, wherein

said rendering further comprises the steps of:

-; defining a viewing vector perpendicular to a plane containing the vector

of interest and the vascular central axis forming a scan line through the

vascular structure and along the vector of interest, wherein said scan line

includes a left point, a center point, and a right point;

-; forming a square bounding box about the convex hull, wherein the

intersection of each scan line with the bounding box defines a rendering

range;

-; and emitting a ray through each pixel within the rendering range,

wherein the rendering depth of the ray is within the maximum radius of the

hull.

As claims 19-26 are dependent upon claim 18, they too carry forth the same

limitations, and are not taught by the prior art.

9.   Claims 14-16 are allowed.

c. The prior art fails to teach the method of Claim 14, which specifically

comprises the following features in combination with other recited limitations:

-; A method of visualizing a vascular structure, said method comprising the

steps of:

-; providing a digital image of a vascular structure wherein said image

comprises a plurality of intensities corresponding to a domain of points in

a D-dimensional space;

-; selecting a vascular central axis and a vector of interest in the image of

the vascular structure, and forming a plurality of cross sections

perpendicular to said vascular central axis;

-; forming a convex hull to enclose each cross section, wherein said

convex hull is oriented by said vector of interest and determined by the

shape of the cross section;

-; connecting each convex hull to form a biconvex slab;

-; defining a viewing vector perpendicular to a plane containing the vector

of interest and the vascular central axis;

-; forming a scan line through the vascular structure and along the vector

of interest, wherein said scan line includes a left point, a center point, and

a right point;

-; forming a square bounding box about the convex hull, wherein the

intersection of each scan line with the bounding box defines a rendering

range;

-; and emitting a ray through each pixel within the rendering range,

wherein the rendering depth of the ray is within the maximum radius of the

hull.

As claims 15-16 are dependent upon claim 14, they too carry forth the same

limitations, and are not taught by the prior art.

Some closely related prior art references are listed above, and the references cited in

form PTO-1449. None of the references teaches the *method* recited in claim 14.

Especially, the references used in the rejection of the other claims are the most relevant

references; Carroll et al. (US Patent 6,501,848 B1, hereby referred to as "Carroll"),

Yanof et al. (US Patent 5,734,384, hereby referred to as "Yanof"), and Kanitsar et al.

("Advanced Curve Planar Reformation: Flattening of Vascular Structures", IEEE

Visualization 2003, October 2003, hereby referred to as "Kanitsar"). Carroll and Yanof

both teach a method for three-dimensional vascular visualization, and were used in

combination with Kanitsar to teach the methods for claims 1 and 17. Kanitsar, which was used in combination, teaches a method for three-dimensional vascular data visualization that is the most similar to the instant, but also fails to teach that the method of rendering would have the following limitations:

-; defining a viewing vector perpendicular to a plane containing the vector of interest and the vascular central axis;

-; forming a scan line through the vascular structure and along the vector of interest, wherein said scan line includes a left point, a center point, and a right point;

-; forming a square bounding box about the convex hull, wherein the intersection of each scan line with the bounding box defines a rendering range;

-; and emitting a ray through each pixel within the rendering range, wherein the rendering depth of the ray is within the maximum radius of the hull.

These limitations are also recited in claims 2 and 18, and are not taught by the prior art, either alone or in combination. As a result, the claim language for claims 14-16 which is highly dependent upon these limitations is allowable over the prior art, and can be used to overcome the prior art rejections cited for claims 1 and 17, as noted above.

Conclusion

10.   The prior art made of record in form PTO-892 and not relied upon is considered

pertinent to applicant's disclosure.

        Wenli Cai, "3D planar reformation of vascular central axis surface with biconvex

slab", Computerized Medical Imaging and Graphics 31 2007 570-576, Received

17 April 2006; received in revised form 11 May 2007; accepted 25 June 2007.

Available online at www.sciencedirect.com.

Kanitsar, "Dissertation: Curved Planar Reformation for Vessel Visualization",

TECHNISCHE UNIVERSITÄT WIEN Institut für Computergraphik und

Algorithmen, Arbeitsbereich ComputergraphikPublished January 2004,

Supervisor: M. Eduard Gröller, Duration: March 2001 - January 2004, Available

online: http://www.cg.tuwien.ac.at/research/publications/2004/Kanitsar-thesis/.

Bailey; Anthony et al., US 7061484 B2, User-interface and method for curved

multi-planar reformatting of three-dimensional volume data sets.

Rudy, Yoram et al., US 20040082870 A1, Systems and methods for determining

a surface geometry.

Levoy; Marc et al., US 6097394 A, Method and system for light field rendering.

        Any inquiry concerning this communication or earlier communications from the

examiner should be directed to TAHMINA ANSARI whose telephone number is 571-

270-3379. The examiner can normally be reached on 8:30 am - 5:00 pm.

        If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Bhavesh Mehta can be reached on 571-272-7453. The fax phone numbers

for the organization where this application or proceeding is assigned are 571-273-8300

for regular communications and 571-273-8300 for After Final communications. TC

2600's customer service number is 571-272-2600.

Any inquiry of a general nature or relating to the status of this application or

proceeding should be directed to the receptionist whose telephone number is 571-272-

2600.

/Bhavesh M Mehta/

Supervisory Patent Examiner, Art Unit 2624

2624

/TA/

October 6, 2010